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MAPPING THE UNKNOWN EVERGLADES

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Every engineer has dreamed at one time or another of jobs in some faraway land of mystery. Few of us realize this opportunity. Fewer still have the satisfaction of completing such a project. Obstacles such as adverse living conditions, dangers, etc. usually dull the excitement of exploration.

However, without leaving the State of Florida we have just completed the mapping for flood control studies of an unexplored area located practically within shouting distance of one of America's fastest growing cities. Ninety-nine percent of the work was done in the office, and furthermore, the time and cost was considerably less than if usual mapping methods had been used.

The 208 million dollar Central and Southern Florida Flood Control Project was launched in 1949. The area covered reaches into 17 Florida counties and includes an area equal to one third the entire State of Pennsylvania, more than 10 million acres. This project, initiated after the devastating 1947 Florida floods, was designed with a two-fold purpose. Primarily, it will protect the developed urban and rural areas from floods. Also, it will ultimately open up hundreds of thousands of acres of new, fertile land for settlement.

In addition, surplus waters will be stored in man-made Water Conservation Areas, to prevent over-drainage and to guard against salt-water intrusion from the ocean into domestic water supplies.

The noted economist Roger W. Babson has stated that South and Central Florida can easily grow enough vegetables to supply the entire nation. Those who are familiar with the area and the planning of the Flood Control District readily concur with this statement.

The physical appearance of the area is from extremely flat to low rolling. With the exception of the Florida pine and some cypress swamps, the natural vegetation is mostly low palmetto scrubs and tropical grasses. The soil of the area we know as the mysterious Everglades, that grassy marsh roughly 40 miles wide and 100 miles long, is muck and peat that have been formed from partly decayed aquatic plants, particularly sawgrass. The depth of this spongy matter ranges from a few inches to several feet. This organic soil when relieved of a high water-table dries out rapidly and becomes a fire hazard. On occasions some of these soils have burned continuously for almost three months.

South Florida's change in the seasons of the year relates more to the amount of rainfall than to the difference in temperature. In the autumn and winter months there is little or no precipitation while the months of July, August and September normally record 40% of the total annual rainfall.

Winter truck farming and sugar cane production in the Everglades is astounding. For example, only a fraction of Palm Beach County is under cultivation, yet this County ranks second in the nation in truck products.

Most of the acreage of the Drainage District is devoted to cattle raising. This calls for large tracts. The density of population per square mile varies

from 2.4 persons per square mile in Glades County to 409 persons per square mile in the Miami Urban Area. The average for the Flood Control District is nearly 62 persons per square mile.

Although Miami's airport ranks with the nation's largest in volume and the City is served with modern trains, highways and sea-going vessels, transportation a few miles west of here is extremely difficult.

During dry seasons one may walk for miles through the Glades. But care should be taken to avoid gator holes, made by the alligators in search of the disappearing waters during the drying season, or the holes left by peat muck fires. Old Fords and light tractors equipped with very large tires have proven a satisfactory means of transportation. But during the wet season, travel in the Glades is another story. The only practicable method of transportation then is by flat bottom shallow draft boats propelled by airplane engines. These boats follow "tracks" made on previous trips and often reach high speeds as they roar through the shallow marshes.

Distances are great in the Flood Control District. For example, it is only ten miles farther from Boston to Philadelphia than it is from one end of the District to the other end. It is physically impossible for one person to keep up-to-date on current activities throughout the 15,000 square mile project. Reconnaissance inspection tours are most practically made via airplane. Such trips are ideal for personal inspection but are of limited value in detail planning.

Adequate standard maps of the area are rare. The United States Geological Survey has recently published standard maps by the U. S. Coast Survey of the East Coast line. Small scale land-use soils maps cover the southeastern portion of the District. The Corps of Engineers has compiled a large scale photo-map of the Kissimmee River Valley. The Geological Survey is currently remapping this valley. Recently the Flood Control District initiated a cooperative mapping agreement with several federal agencies for the mapping of the Upper St. Johns River Watershed which lies between the East Coast and the Kissimmee River Valley. Large scale topographic and soils maps will soon be completed of this area. The entire District is covered by the national defense mapping now underway by the Geological Survey. These maps should be available in four to seven years.

Thus, today almost all of the District is covered by maps of some kind. However, scales, types and accuracies vary considerably. The exception was the southwest part of the District. Here the coverage was nil. Also lacking was survey control. One line runs along the Cross-State Canal, splitting and going around both sides of Lake Okeechobee. One first order traverse line follows the Tamiami Trail. The area between - some sixty odd miles - is blank.

The Governing Board, the Operating Staff of the Flood Control District, and the land owners here are in constant need of ways and means to prepare long range plans and supplement existing plans for the use of water which heretofore has been discharged through arterial canals into the Gulf of Mexico and the Atlantic Ocean. Maps are needed to prepare water control plans, to predict the amount of flood protection requirements and to determine the irrigation needs during the long dry winter months when it is economically most advantageous for South Florida to ship its produce to market. These needs were new to this area - all previous developments had been on a rather small scale, haphazard and more often than not to the dismay and discomfort of the individual's neighbors. It became apparent to the far-sighted workers dealing with the water control problems that adequate maps and mapping are

a necessity and not a luxury.

To expedite the engineering planning and the necessary public relations, the officials of the FCD needed a method of studying the area at the conference table. It was necessary that this representation indicate direction of drainage flow in areas of as little as one foot elevation change. The presentation should show detailed breakdown of topography and land use. Symbols must be readily identified by rancher, politician, farmer, citrus grower and economist as well as engineer. The results must be accurate enough for actual planning, and last but not least, the scale must be small enough to prevent it from being too bulky, but it must be readable. Quick compilation on a limited budget was a prime requisite.

Current aerial photographic costs at $2.70 to $4.00 per square mile would be a staggering cost for a room full of pictures. Standard topographic mapping at $175.00 per square mile would nearly ruin the Flood Control District's budget, and besides, the mapping could not be completed at best under eighteen to twenty-four months.

A form of aerial photography was obviously the answer if the photographs could be procured economically and quickly made into map form.

Fortunately, the entire area had recently been photographed for the Army Map Service, Corps of Engineers. The scale of the photography was approximately 1:60,000. The Army Map Service agreed to sell contact prints covering the area, but because of national defense commitments it could not make individual rectified enlargements of each exposure. This created a serious problem. Tilt and scale differences were present in this photography since it is virtually impossible to photograph a large area and have all exposures at the same scale and tilt-free. Added to that problem was the lack of ground control.

After careful analysis of the pros and cons we decided to construct a mosaic with the available contact prints. The necessary photography was obtained from the Army Map Service to amply cover twenty-four 15' quadrangles.

An aerial triangulation plot was run for the entire area. This was controlled by the horizontal control survey monuments which were located on the fringes. These were recovered in the field and their positions pinpricked on the photos.

In making the aerial triangulation solution we gambled. For some ten or twelve years, I have mulled over certain phases of aerial triangulation. Generally speaking, it seemed to me that we photogrammetrists were exerting 70% of our time and efforts in an endeavor to increase the accuracy the last 5 or 10%.

This degree of near perfect accuracy is highly desirable. But does the need for and the proposed use of the maps justify the extra time and expense? We do not propose to go into this issue at this time, but we sincerely feel that the client should have a strong voice in the final decision.

In our aerial triangulation solution we used an approach that is more or less unorthodox. Several of the detailed steps had to be readjusted, but the end results were most gratifying. Desired accuracy was found not wanting. <u>No supplementary field surveys for control were necessary and months in time were saved.</u>

The results of this triangulation solution gave us the true geographic position of each photo. During this step of the work, several survey control stations were purposely omitted from the triangulation plot. These points were later plotted to check accuracy.

The area was next divided into six 30 minute quadrangles measuring ap-

proximately 32 inches by 36 inches. The voluminous job of mounting the individual photos was next. We held the photo centers and control points to their respective true geographic positions and assembled the mosaic.

For mounting the photos we use an adhesive of our own mixture. This glue becomes "tacky" immediately upon application to the photo back. It takes several hours to set, and consequently we have ample time to shift photos and even remove them if necessary. Excess glue is easily washed off.

Upon completion of the photo-mounting, duplicate photos were ordered to replace ones which were off-tone. Then, by the use of an airbrush, all of the mosaic was touched up.

Since this area had never been completely mapped before, every effort was made to include identification of all land features and sites of historical importance. Maps, charts and reports that dated back as far as 1850 were used in the compilation of these data.

The most difficulty was experienced with Seminole Indian names. The Seminoles have no written language and quite often the white man, having a poor sense of humor, makes the spelling of the Indian names a phonetic guessing game. It was seldom that the so-called authorities agreed and the local usage of the names was at complete variance with the names that had found their way into print. To avoid any more confusion than was necessary, we used as landmark identification names we assumed to be correct.

The borders of the individual sheets were designed so that each mosaic sheet would butt match with all adjacent sheets. These borders contained the usual compilation data, ticks for geographic positions and the state system of coordiantes, a key location map and a photographic symbol legend.

This legend was unique inasmuch as such rarely appears on photo-maps. In addition, the legend gives the map user a positive key for identifying photo images. Finally, the mosaic was photo-copied at the exact scale of one inch equals one mile (1:63,360).

A check was made on the accuracy of the mosaic by plotting the positions of the previously mentioned control stations which were not used to control the mosaic. Also, some brand new U. S. Geological Survey control was used. Fifteen percent of the points check were located as close as could be plotted. Over sixty percent were found to be within 1/10 inch of the true position and only one of the remaining points was off as much as 1/4 inch. Using more exacting methods of compilation, we could have positioned all points so as to fall within 1/20th or even 1/30th inch of true position. But to do this, the time would have been increased four to five times and the cost proportionately.

For the benefit of those who think of map accuracies in terms of 1/50th inch, etc. we would like to explain our reasons for considering our accuracy adequate. The final product will appear either on photographic paper or ordinary blueprint paper. Both of these papers are unstable. So, stretching in excess of 1/10 inch is not uncommon. Areas on this photo-map can be planimetered as close as is readable, and the same holds true for measured distances (including areas that were off geographically). Higher accuracy results would be like hauling a pile of sand for a child's sandpile in a 20 yard "Euc". The pick-up truck is just as good and gets there much quicker.

To meet the so-called national map standards, photography of a different type would have been required.

It was felt that the results were economically feasible. In six months we mapped an area larger than the State of Connecticut, or actually 96 seven and one-half minute quadrangles. The total cost was considerably less than half the present day cost for one seven and one-half minute topographic map.

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